Measuring Trade Facilitation in ASEAN and Its Effects on China-ASEAN Cross-border E-commerce Exports

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Abstract—This paper first establishes an evaluation system consisting of 11 indicators in 3 dimensions and applies the entropy weight method to measure the trade facilitation level of ASEAN countries. Results demonstrate a substantial gap in the level of trade facilitation among ASEAN countries. The paper then analyzes the impact mechanism of trade facilitation on cross-border e-commerce and conducts an empirical analysis using an extended gravity model with data from 2006 to 2020. The study finds that an improvement in trade facilitation in ASEAN will boost China-ASEAN cross-border e-commerce exports. However, the impact of various indicators of trade facilitation differs, with the infrastructure environment and customs environment having a significant positive effect on China-ASEAN cross-border e-commerce exports, while the impact of the policy environment is not significant. Finally, the paper provides recommendations for ASEAN to enhance the development of cross-border e-commerce between China and ASEAN, including ways to improve the level of trade facilitation.

Keywords—trade facilitation, cross-border e-commerce, China-ASEAN, gravity model

I. INTRODUCTION

The COVID-19 pandemic has caused severe disruption to traditional offline sales. In contrast, cross-border e-commerce, with its low cost and high efficiency, has become a favored option for global consumers due to its unique ability to break down time and space limitations. In 2020, ASEAN became the second-largest market for China's cross-border e-commerce exports after the US. Developing the ASEAN market further presents a significant opportunity for China's cross-border e-commerce exports in the future.

In November 2020, the Regional Comprehensive Economic Partnership (RCEP) was signed by ten ASEAN countries, along with China, Japan, South Korea, Australia, and New Zealand, marking the successful launch of the world's largest free trade area. It incorporates a higher level of trade facilitation in the field of rules and regulations, providing a new direction for reform that simplifies administrative procedures and improves infrastructure. This will bring new opportunities for China-ASEAN cross-border e-commerce exports and development.

Trade facilitation has been studied extensively by scholars both theoretically and empirically. John S. Wilson laid the groundwork for research of trade facilitation, using four indicators to evaluate trade facilitation-infrastructure environment, customs environment, government policy environment, and e-commerce (Wilson *et al.*, 2003). In 2011, he divided trade facilitation measures into hard infrastructure and soft infrastructure (Portugal-Perez &

Wilson, 2012). APEC's Second Trade Facilitation Action Plan emphasized that trade facilitation should not be limited to "At the border barriers" but should also extend to "Behind the border barriers." The plan also emphasized the principle of transparency and build a system of indicators in seven categories for evaluating trade facilitation in the Asia-Pacific region (APEC, 2010).

Kim Park (2004) measured the degree of trade facilitation in North and East Asia and selected technical standards, electronic information infrastructure, the degree of business mobility, and customs procedures indicators. The OECD emphasizes the linkage between regional growth and geographical balance and takes the saving of cross-border logistics time as the main means of trade facilitation (OECD, 2005). Zhu (2015) measured the level of trade facilitation with five indicators: customs efficiency, tariffs, infrastructure environment, information and communication technology, and business environment. These studies provide insights into the development of trade facilitation measures and the evaluation system.

The main models of empirical research on trade facilitation are the gravity model and the Global Trade Analysis Project (GTAP) model. Tinbergen (1962) and Poyhonen (1963) proposed the gravity model, which assumes that the flow of trade between two economies is directly relative to the size of their economies and inversely relative to the distance between them. By applying gravity model, Shepherd & Wilson (2009) found that ASEAN's trade flows are closely related to the level of trade facilitation in their country, and that an increase in the level of trade facilitation can bring great advantages for the economy of Southeast Asian countries. Tae-Young (2014) found that the total economic volume of the exporting country is directly related to the potential production capacity, and the total economic volume of the importing country is directly related to the potential demand. Portugal-Perez& Wilson (2009) used a gravity model to study trade facilitation in African countries. The evidence suggests that the gains for African exporters from cutting trade costs half-way to the level of Mauritius has a greater effect on trade flows than a substantial cut in tariff barriers. Evdokia and Silvia (2013) used a gravity model to analyze the differential impact of trade facilitation measures in a selected group of countries. Ramasamy *et al.* (2017) extended the trade gravity model by adding the characteristics of the Belt and Road countries as selected variables and concluded that improved trade facilitation procedures can increase trade flows between countries.

The GTAP model has been used for quantitative analysis of regional economic integration policies. Francois *et al.* (2005)

used the GTAP model to assess the economic effects of trade liberalization between the EU and developing countries, finding that the establishment of the free trade area resulted in a significant increase in exports of EU and EU gained more welfare effects than developing countries from the free trade area.

While there is a consensus on the role of trade facilitation in promoting trade flows, research on the impact of trade facilitation on cross-border e-commerce is limited. With the entry into force of RCEP, cross-border e-commerce trade between China and ASEAN has become more important. This paper will focus on measuring the level of trade facilitation in ASEAN countries and empirically analyzing the impact of ASEAN trade facilitation on cross-border e-commerce between China and ASEAN countries using the latest data.

II. CHINA'S CROSS-BORDER E-COMMERCE EXPORTS TO ASEAN

Cross-border e-commerce is a relatively new form of trade that is characterized by the unique features of small batch size and high frequency, which makes it challenging to obtain comprehensive data on the scale of cross-border e-commerce transactions between China and ASEAN countries. To address this issue, this paper draws on the methodology of iResearch, and calculates China-ASEAN cross-border e-commerce data by using the following formula:

$$EEXi = EEX \times \frac{EXi}{EX} \qquad (1)$$

EEXi is China's cross-border e-commerce exports to ASEAN country i; EEX is China's total cross-border e-commerce exports; EXi is China's export to ASEAN country i; EX is China's total exports.

Table 1. China's cross-border e-commerce exports to ASEAN countries, 2010–2020 (billion yuan)

Countries	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total export	Sur-plus
Brunei	0.24	0.61	1.14	2.08	2.66	2.79	3.29	4.16	4.55	2.09	1.75	25.36	21.91
Cambodia	0.86	1.89	2.46	4.17	4.99	7.45	10.3	13.31	17.15	25.64	30.17	118.39	111.26
Indonesia	14.06	23.86	31.13	45.14	59.53	67.97	84.21	96.75	123.32	146.65	153.48	846.10	652.13
Laos	0.31	0.39	0.85	2.11	2.8	2.43	2.59	3.95	4.15	5.66	5.59	30.83	19.42
Malaysia	15.24	22.77	33.16	56.14	70.65	87.05	98.75	116.11	129.56	167.51	210.86	1007.80	604.54
Myanmar	2.23	3.94	5.15	8.97	14.28	19.10	21.47	24.91	30.12	25.64	46.99	202.80	166.49
Philippine	7.39	11.64	15.19	24.28	35.78	52.79	78.23	89.26	100.04	130.96	156.86	702.42	578.26
Singapore	20.71	29.04	37.00	56.02	74.55	102.81	116.67	125.31	140.01	176.05	215.83	1094.00	904.69
Thailand	12.64	20.98	28.32	39.99	52.26	75.79	97.49	107.28	122.43	146.45	189.19	892.82	616.80
Vietnam	14.79	23.75	31.06	59.39	97.13	130.67	160.19	199.35	239.49	314.42	426.27	1696.51	1356.01

Data source: National Bureau of Statistics, Wind, General Administration of Customs and Excise

Table 1 presents data on the size of China's cross-border e-commerce export to ASEAN countries from 2010 to 2020. The results show that:

China's cross-border e-commerce exports to all ASEAN countries have witnessed a growth trend, albeit with uneven development across countries. Vietnam emerges as the country with the highest cumulative Chinese cross-border e-commerce exports in 2010–2020, reaching 1696.51 billion yuan, followed by Singapore and Malaysia, both exceeding 1 trillion yuan. Thailand and the Philippines constitute the second echelon with a cumulative total of 892.82 billion yuan and 702.42 billion yuan, respectively. Myanmar and Cambodia constitute the third echelon, with China's cross-border e-commerce exports accumulating 202.80 billion yuan and 118.39 billion yuan from 2010 to 2020, respectively. Laos and Brunei rank as China's least exported cross-border e-commerce countries, with a cumulative total of only 30.83 billion yuan and 25.36 billion yuan from 2010 to 2020.

China's cross-border e-commerce exports to ASEAN countries are larger than its imports, maintaining a large surplus. Among them, China's largest cross-border e-commerce export surplus countries are Vietnam and Singapore, with a cumulative surplus of 1356.01 billion yuan and 904.69 billion yuan from 2010 to 2020. Indonesia, Thailand, Malaysia, and the Philippines constitute the second echelon, with China's cumulative cross-border e-commerce export surplus from 2010 to 2020 totaling 652.13 billion yuan, 616.80 billion yuan, 604.54 billion yuan, and 578.26 billion yuan, respectively. Myanmar and Cambodia constitute the third echelon, with China's cumulative cross-border e-commerce export surplus of 166.49 billion yuan and 111.26 billion yuan from 2010 to 2020, respectively. Brunei and Laos rank last, with China's cumulative cross-border e-commerce export surplus from 2010 to 2020 amounting to only 21.91 billion yuan and 19.42 billion yuan, respectively.

III. PATHWAYS THROUGH WHICH TRADE FACILITATION IMPACTS CROSS-BORDER E-COMMERCE EXPORTS

Trade facilitation encompass the entire trade process from customs clearance to transportation infrastructure and digital connectivity. This paper analyzes how these initiatives impact cross-border e-commerce through 4 pathways: streamlined customs procedures reducing delays and costs, favorable government policies incentivizing e-commerce

growth, improved infrastructure speeding up the flow of goods, and advanced information and communication technologies enabling online transactions.

A. Streamlined Customs Procedure and Cross-border E-commerce

The customs clearance considers factors like: the complexity of customs procedures, non-tariff barriers, irregular payments and the protection of Intellectual Property Rights (IPR). Customs clearance efficiency refers to the time spent on documentation and mandatory procedures and formalities that cross-border goods require for customs declaration and clearance. It also includes the cost that enterprises must bear for this purpose. The longer the time required, the lower the efficiency of a country or region's customs system.
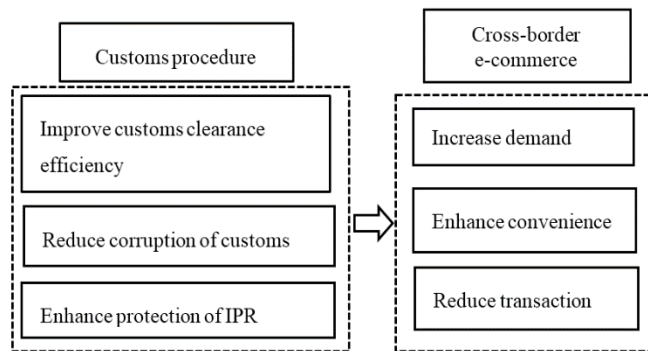

Fig. 1. Pathways of customs procedure's impact on cross-border e-commerce.

Cross-border e-commerce has characteristics like small-batch shipments and diversity of product types which require higher customs clearance efficiency to shorten customs clearance times as much as possible. This ensures that cross-border e-commerce trade occurs quickly and orderly, enhancing the shopping experience for consumers and businesses.

From an economic perspective, when other transaction costs remain unchanged, reducing customs clearance costs will reduce the costs of cross-border e-commerce trade. This will increase consumer demand, conducive to promoting the development of cross-border e-commerce. Fig. 1 illustrates how customs procedures, including IPR protection measures, affect cross-border e-commerce.

B. Supportive Government Policy and Cross-border E-commerce

According to Keynes's "visible hand" and the theory of government intervention, government policy plays a fundamental role in shaping market outcomes. Supportive government policies are essential for effective trade facilitation, requiring an open, transparent government that formulates business-friendly regulations and systems to facilitate cross-border e-commerce growth.

In terms of trade facilitation indicators, the government policy and institutional environment includes the policy transparency, the burden of government regulation and management, judicial independence and the efficiency of dispute settlement mechanism. Political stability leads to high administrative efficiency, enhancing enterprise participation in international trade. However, low integrity in government departments reduces efficiency and increases costs for cross-border trade. Fig. 2 shows the ways in which government policy affects cross-border e-commerce.
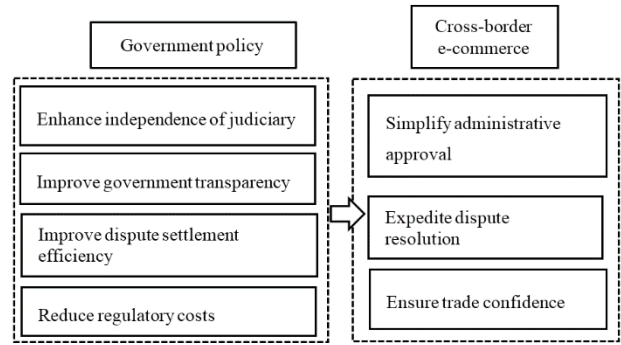

Fig. 2. Pathways of government policy's impact on cross-border e-commerce.

C. Improved Infrastructure and Cross-border E-commerce

Apart from digitized products, the majority of goods traded through cross-border e-commerce still require physical transportation and distribution. Therefore, infrastructure is an important factor influencing cross-border e-commerce development. To accommodate its "small batch, multi-batch" nature, cross-border e-commerce needs optimization of logistics systems and improvements in the quality and efficiency of transportation. Relevant infrastructure for trade facilitation includes the quality of roads, railroads, ports and aviation.
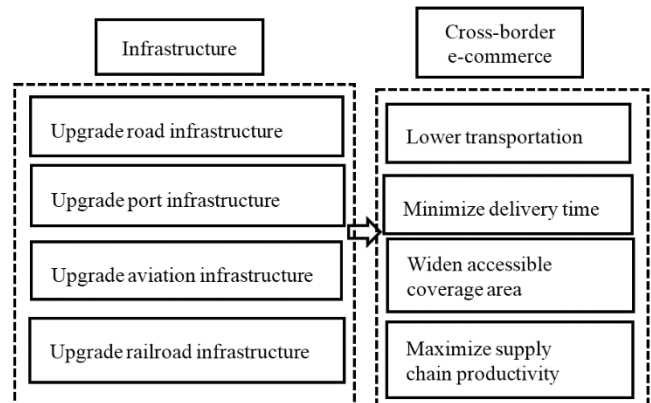

Fig. 3. Pathways of Infrastructure's impact on cross-border e-commerce

Increasing infrastructure coverage augments logistics capacity, reduces transportation costs and thereby lowers transaction costs, all of which facilitate cross-border e-commerce growth. Higher infrastructure quality also diminishes spoilage and damage during transport, benefiting businesses and consumers. Fig. 3 shows how infrastructure affects cross-border e-commerce.

D. Advanced ICT and Cross-border E-commerce

Communication technology underpins cross-border e-commerce at every stage, from order payments to post-sale services. Countries with more advanced ICT tend to see greater uptake of technology in foreign trade activities. Strong ICT infrastructure benefits cross-border e-commerce in multiple ways. A larger Internet user base points to more developed ICT. Faster adoption of new technologies suggests stronger R&D capabilities, allowing quicker improvements to the e-commerce environment, payments system and trade efficiency.
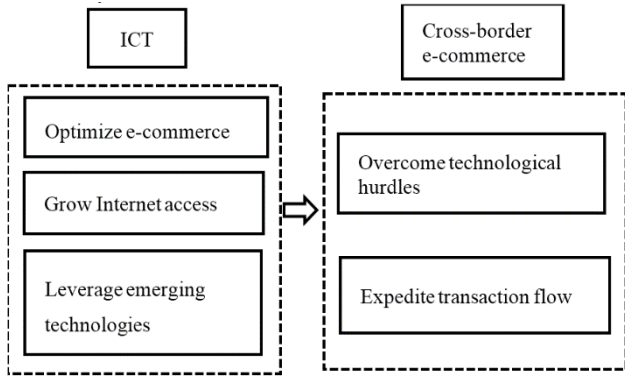
Fig. 4. Pathways of ICT's impact on cross-border e-commerce.

In general, advanced communication technology overcomes limitations of traditional trade by significantly reducing transaction costs and times while improving efficiency. The relationship between ICT development and cross-border e-commerce is thus mutually reinforcing: as ICT improves, it facilitates e-commerce growth, which then drives further ICT development. Fig. 4 lists the ways in which communication technology affects cross-border e-commerce.

IV. MEASURING THE TRADE FACILITATION IN ASEAN COUNTRIES

A. Trade Facilitation Indicators and Weights

This paper measures the trade facilitation of ASEAN countries based on three dimensions: infrastructure, government policy, and customs procedure. ICT is excluded to ensure the measurement's accuracy and reliability, given data limitations. Under each dimension are secondary indicators, as shown in Table 2.

Table 2. Trade facilitation indicators and their weights

Dimension	Secondary indicators	Notation	Weights
Infrastructure	Quality of road infrastructure	a1	0.0852
	Quality of railroad infrastructure	a2	0.1249
	Quality of port infrastructure	a3	0.1021
	Quality of aviation infrastructure	a4	0.0885
Government policy	Policy transparency	b1	0.1114
	Government regulation/management burden	b2	0.0431
	Efficiency of legal dispute settlement mechanisms	b3	0.0618
	Judicial independence	b4	0.0690
Customs procedure	Intellectual Property Right Protection in Customs	c1	0.0507
	Customs procedural burden	c2	0.1042
	Custom integrity index	c3	0.1592

B. Trade Facilitation Level in ASEAN Countries

The following formula is used to calculate the trade facilitation level for each ASEAN country for each calendar year:

$$TF = \sum_{m=1}^{11} a_m \times wa_m \qquad (2)$$

In the above equation, a is the standardized indicator value and wa is the corresponding weight of the indicator. Table 3 shows the trade facilitation level of ASEAN countries from 2006 to 2020.

Table 3. Trade facilitation level in ASEAN countries, 2006-2020

Country	2006	2008	2010	2012	2014	2016	2018	2020	Average
Philippine	0.1824	0.2071	0.1593	0.2257	0.2920	0.2689	0.2658	0.2484	0.2322
Cambodian	0.1144	0.1877	0.2342	0.3174	0.1928	0.2204	0.2239	0.3310	0.2260
Laos	0.4165	0.4165	0.3825	0.3516	0.3063	0.2994	0.3264	0.3420	0.3555
Malaysia	0.6589	0.6390	0.6331	0.6498	0.6840	0.6823	0.6739	0.6471	0.6604
Burma	0.3875	0.3996	0.3943	0.4033	0.3994	0.4054	0.4181	0.4225	0.4049
Thailand	0.5301	0.5165	0.5009	0.4641	0.4305	0.4601	0.4553	0.4728	0.4773
Brunei	0.4430	0.4263	0.4231	0.4507	0.4851	0.4021	0.3978	0.4263	0.4343
Singapore	0.9366	0.9712	0.9590	0.9520	0.9329	0.9344	0.9596	0.9666	0.9464
Indonesia	0.2101	0.2958	0.3541	0.3472	0.4135	0.4063	0.4168	0.3769	0.3549
Vietnam	0.2485	0.2693	0.2884	0.2599	0.3012	0.3373	0.2880	0.2580	0.2838

Singapore's trade facilitation score was much higher than other countries' at around 0.9. Malaysia's score was stable at around 0.6 during this period. Thailand, Brunei Darussalam, Myanmar, Indonesia and Laos' scores were around 0.4, with Brunei Darussalam and Myanmar being more stable at around 0.4. Thailand's score was above 0.5 from 2006 to 2010 before dropping to around 0.45. Laos was above 0.4 from 2006 to 2008 but then declined to around 0.35. Indonesia's trade facilitation grew to 0.4 in the early period but fell to around 0.35 after 2016. Cambodia, Vietnam and the Philippines were at the bottom with low trade facilitation scores.

V. EMPIRICAL ANALYSIS

A. Research Hypothesis

Based on the analysis of impact pathways in part 3, the following hypotheses were formulated as shown in Table 4.

	Research hypothesis
H1	The trade facilitation in ASEAN enhances China-ASEAN cross-border e-commerce exports
H2	The improvement of infrastructure in ASEAN enhances China-ASEAN cross-border e-commerce exports
H3	The improvement of government policy in ASEAN enhances China-ASEAN cross-border e-commerce exports
H4	The improvement of customs procedure in ASEAN enhances China-ASEAN cross-border e-commerce exports

B. Model Specifications

This paper uses the classical gravity model to study bilateral trade between China and ASEAN in cross-border e-commerce:

$$\ln M_{ij} = a_0 + a_1 \ln GDP_i + a_2 \ln GDP_j + a_3 \ln DIS_{ij} + \varepsilon_{ij} \quad (3)$$

where M is the export trade flow from country i to country j, i is the GDP of China, j is the GDP of ASEAN countries, DIS refers to the product of the geographical distance between China and ASEAN countries and the average

annual oil price. a_0 is the constant term, ε is the random perturbation term. a_x is the regression coefficient.

To test the influence of various indicators on the level of China-ASEAN cross-border e-commerce exports, the gravity model is extended as:

$$\ln EEV_{it} = \alpha_0 + \alpha_1 \ln TF_{it} + \alpha_2 \ln GDP_{it} + \alpha_3 \ln GDP_{jt}$$

$$+\alpha_4 \ln POP_{it} + \alpha_5 \ln DIS_{ij} + \alpha_6 \ln IT_{it} + \varepsilon_{it} \quad (4)$$

where t denotes the year. TF_{it} is the level of trade facilitation in the importing country. GDP_{it} is GDP of the exporting country, GDP_{jt} is the GDP of the importing country, POP_{it} is the total population of ASEAN countries, and DIS_{ij} refers to the product of geographic distance between China and ASEAN countries and average annual oil price. IT_{it} is the average import tariff of ASEAN countries, ε is the constant term and ε is the random perturbation term. α_x is the regression coefficient.

If α_x is positive and the test statistic is significant, then the factor has a positive influence on China-ASEAN cross-border e-commerce exports, and vice versa for negative influence. The remaining variables are judged similarly. The variables and data sources used in the empirical analysis are detailed in Table 5.

Table 5. Variable description and data sources

	Variable	Description	Unit	Data sources
Dependent variable	EEV	China's cross-border e-commerce exports to ASEAN countries	billions of dollars	
Core explanatory variables	TF	Trade facilitation in ASEAN countries	-	Global Competitiveness Report 2006–2020, World Economic Forum (China) National Bureau of Statistics
	TF1	Infrastructure in ASEAN countries	-	
	TF2	Government policy in ASEAN countries	-	
	TF3	Customs procedure in ASEAN countries	-	
	GDP_i	GDP of exporting countries	billions of dollars	
Control variable	GDP_j	GDP of importing countries	billions of dollars	World Bank
	POP	Population of ASEAN coutries		World Bank
	DIS	Product of geographic distance between China and ASEAN countries and average annual oil price	-	CEPII database
	IT	Average import tariffs in ASEAN countries	%	World Bank

C. Baseline Regression Results

Before regression, least squares regression was performed on Eq. (4) to avoid bias from multicollinearity. The variance inflation factors were tested, with results in Table 6. The highest, lowest and average variance inflation factors were 6.01 (lnPOP), 1.04 (lnDIS) and 3.03 respectively. As none exceeded the threshold of 10, the test shows that results are not affected by severe multicollinearity.

Table 7 shows the baseline regression results. Model (1) includes only the core explanatory variable lnTF while Model (2) incorporates control variables. The core explanatory variables are positive and significant in both regressions, indicating improved trade facilitation increases China's cross-border e-commerce exports to ASEAN countries.

In Model (2), the coefficient of 0.4579 for lnTF is significant at the 1% level, indicating that ASEAN's trade facilitation positively affects China-ASEAN cross-border e-commerce exports, which rise y 0.4579% for every 1%

increase in facilitation scores. The coefficient of 2.2699 for lnGDPch is significant at the 1% level, indicating that China's economic development positively affects China-ASEAN cross-border e-commerce exports, which rise by 2.2699% for every 1% increase in China's GDP. The coefficient of 0.5387 for lnGDPas is significant at the 1% level, indicating that ASEAN's economic development positively affects China-ASEAN cross-border e-commerce exports, which rise by 0.5387% for every 1% increase in ASEAN countries' GDP. The coefficient of 0.4223 for lnPOP is significant at the 1% level, indicating that population size positively affects exports. The coefficient of −0.0467 for lnDIS is significant at the 5% level, indicating that geographic distance negatively affects China-ASEAN cross-border e-commerce exports, which fall by 0.0467% for every 1% increase in distance. The coefficient of −0.2407 for lnIT is significant at the 5% level, indicating that tariff levels negatively affect China-ASEAN cross-border e-commerce exports, which fall by 0.2407% for every 1% increase in tariffs.

Table 6. Multicollinearity test

Variable	VIF	Tolerances
lnPOP	6.01	0.1664
lnGDP$_j$	4.78	0.2090
lnIT	2.97	0.3364
lnTF	2.22	0.4513
lnGDP$_i$	1.14	0.8788
lnDIS	1.04	0.9635
Average	3.03	0.5009

Table 7. Baseline regression results

Variable	Model (1) Y=lnEEV	Model (2) Y=lnEEV
lnTF	1.1319***	0.4579***
	(0.2756)	(0.1625)
lnGDP$_i$		2.2699***
		(0.1502)
lnGDP$_j$		0.5387***
		(0.0807)
lnPOP		0.4223***
		(0.0868)
lnDIS		−0.0467**
		(0.0235)
lnIT		−0.2407***
		(0.0750)
constant variable	3.8301***	−28.4597***
	(0.2972)	(1.7984)
N	150	150
R²	0.0560	0.8748

Note: *, ** and *** denote 10%, 5% and 1% significance levels, respectively; robust t-statistics in parentheses

D. Robustness Tests

This paper uses three approaches for robustness testing: Bootstrap repeat sampling 1,000 times; Considering lagged effects of indicators on export levels; Excluding the 2020 sample to mitigate the impact of COVID-19 pandemic on economic activity.

Table 8 shows results from these three robustness tests. lnTF's coefficients in all three regressions are positive and significant at 5%, indicating the result that "trade facilitation promotes cross-border e-commerce exports" has high robustness. This verifies the hypotheses in Table 4.

E. Dimensional Regression

Replacing trade facilitation level with infrastructure, government policy, and customs procedure in the regression, results are shown in Table 9.

The coefficient for lnTF1 (infrastructure in ASEAN countries) is 0.4159 significant at 1%, indicating infrastructure positively affects China-ASEAN cross-border e-commerce exports, which rise 0.4159% for every 1% increase in infrastructure level.

Table 8. Robustness test results

Variable	Bootstrap repeat sampling	One period lag of core independent variables	Excluding the 2020 sample
lnTF	0.4579***	0.3346**	0.4413***
	(0.1601)	(0.1614)	(0.1653)
lnGDP$_i$	2.2699***	2.3861***	2.2658***
	(0.1438)	(0.1840)	(0.1642)
lnGDP$_j$	0.5387***	0.5883***	0.5248***
	(0.0826)	(0.0786)	(0.0834)
lnPOP	0.4223***	0.3603***	0.4281***
	(0.0902)	(0.0846)	(0.0895)
lnDIS	−0.0467*	−0.0172	−0.0453*
	(0.0260)	(0.0181)	(0.0237)
lnIT	−0.2407***	−0.2135***	−0.2644***
	(0.0778)	(0.0767)	(0.0765)
constant variable	−28.4597***	−30.1967***	−28.3623***
	(1.7403)	(2.2064)	(1.9386)
N	150	140	140
R²	0.8748	0.8602	0.8709

Note: *, ** and *** denote 10%, 5% and 1% significance levels, respectively; robust t-statistics in parentheses

Table 9. Dimensional regression results

Variable	Model (1) X= lnTF1	Model (2) X= lnTF2	Models (3) X= lnTF3
lnTF1	0.4159***		
	(0.1228)		
lnTF2		−0.0358	
		(0.1876)	
lnTF3			0.6148**
			(0.2432)
lnGDP$_i$	2.3113***	2.2413***	2.2025***
	(0.1474)	(0.1576)	(0.1452)
lnGDP$_j$	0.5449***	0.6370***	0.4930***
	(0.0791)	(0.0714)	(0.0893)
lnPOP	0.4234***	0.3457***	0.4183***
	(0.0874)	(0.0878)	(0.0716)
lnDIS	−0.0500**	−0.0467*	−0.0426**
	(0.0236)	(0.0245)	(0.0202)
lnIT	2.3113***	2.2413***	2.2025***
	(0.1474)	(0.1576)	(0.1452)
constant variable	−28.5677***	−28.6466***	−26.5514***
	(1.8027)	(1.8984)	(1.8405)
N	150	150	150
R²	0.8761	0.8707	0.8800

Note: *, ** and *** denote 10%, 5% and 1% significance levels, respectively; robust t-statistics in parentheses

The coefficient for lnTF3 (customs procedure in ASEAN countries) is 0.6148 significant at 1%, indicating customs clearance positively affects China-ASEAN cross-border e-commerce exports, which rise 0.6148% for every 1% increase in customs procedure level.

The coefficient for lnTF2 (government policy in ASEAN countries) is not significant, indicating government policy has a relatively weak influence on China-ASEAN cross-border e-commerce exports.

The results suggest that the government policy environment is not the most crucial determinant of trade facilitation levels

in ASEAN. While improving trade facilitation undoubtedly requires governmental policies that support cross-border e-commerce, such policies appear to play a secondary role.

Fundamentally enhancing trade facilitation levels likely requires a primary focus on infrastructure development and customs procedure optimization. Infrastructure upgrading and customs streamlining seem to have a more considerable impact on trade facilitation and cross-border e-commerce exports relative to governmental policies.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusion

This study examined the impact of trade facilitation on China-ASEAN cross-border e-commerce exports. We find:

ASEAN countries exhibit large disparities in the scale of their cross-border e-commerce and trade facilitation levels. Vietnam, Singapore and Malaysia have the highest cross-border e-commerce imports from China, followed by Thailand and the Philippines. Myanmar, Cambodia, Laos and Brunei have much lower imports.

The gravity model shows that for every 1% increase in ASEAN's trade facilitation scores, China-ASEAN cross-border e-commerce exports rise by 0.4579%. Tariffs, geographical distance and economic development have great impact on exports.

B. Recommendations

As China's cross-border e-commerce continues to grow, the ASEAN region emerges as a key trading partner. Enhancing bilateral e-commerce and facilitating trade are imperative steps toward increasing future import and export volumes. We recommend:

First, synergistically developing logistics infrastructure by: leveraging the Belt and Road Initiative to construct multi-functional logistics hubs and services in ASEAN given uneven infrastructure development; and establishing intelligent warehouses and logistics centers with China's comprehensive industrial advantages.

Second, simplifying customs procedures through China-ASEAN customs cooperation to develop an efficient Single-window System; allowing import and export declarations, automating auditing and providing instant feedback to streamline the process.

Third, improving policy transparency and legal frameworks by strengthening government supervision of cross-border e-commerce through enhanced domestic laws; complying with international trade rules and adopting best practices from advanced economies; and jointly establishing transaction regulations through exploring reforms in dispute resolution and transparency to protect sustainable cross-border e-commerce development.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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